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[54] **LIQUID APPLICATION WITH RESILIENT SUPPORT**

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Oct. 29, 1991 [JP] Japan ..... 3-88765[U]

[51] **Int. Cl.**[5] **B43K 8/02**

[52] **U.S. Cl.** **401/206**; 401/54; 401/81; 401/214

[58] **Field of Search** 401/54, 81, 206, 214

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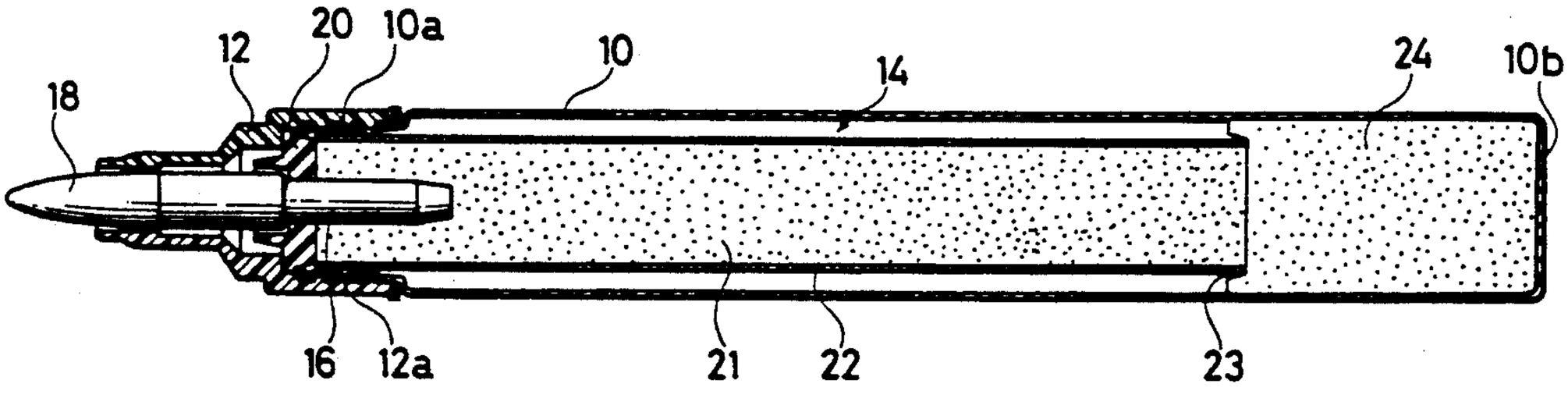
[57] **ABSTRACT**

A liquid applicator includes a tubular casing, a liquid holding member, and a support member. The support member whose modulus of elasticity is smaller than that of the liquid holding member is provided between a bottom end portion of the liquid holding member and a bottom wall of the casing. The support is formed such that at least a portion of an outer circumferential surface of the support member is in pressing contact with an inner circumferential surface of the casing and that the support member is compressively deformable in an axial direction thereof while being held tightly between the liquid holding member and the bottom wall of the casing. Accordingly, the liquid holding member can be reliably supported in the casing.

11 Claims, 4 Drawing Sheets



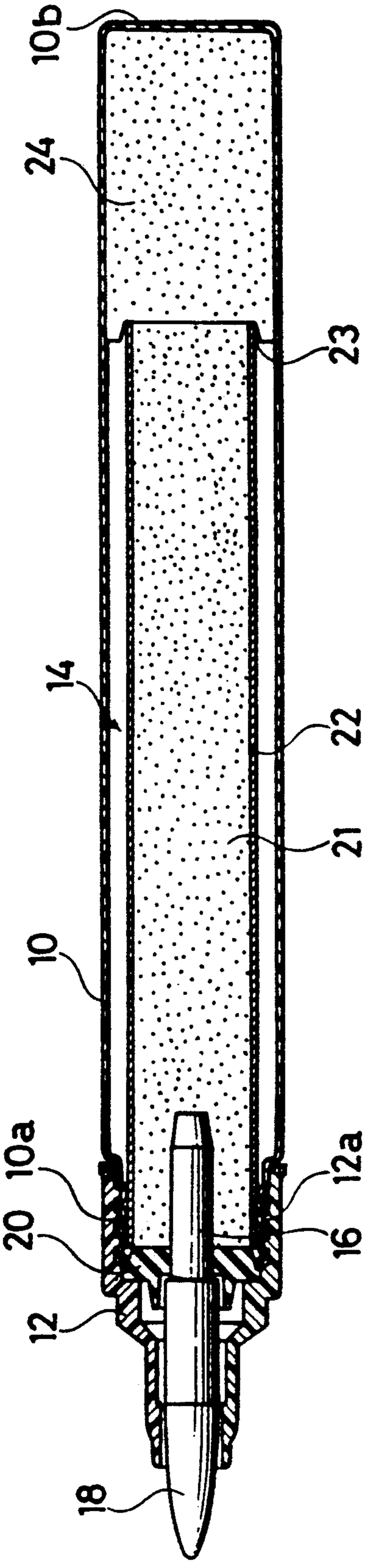


FIG. 1

FIG. 2

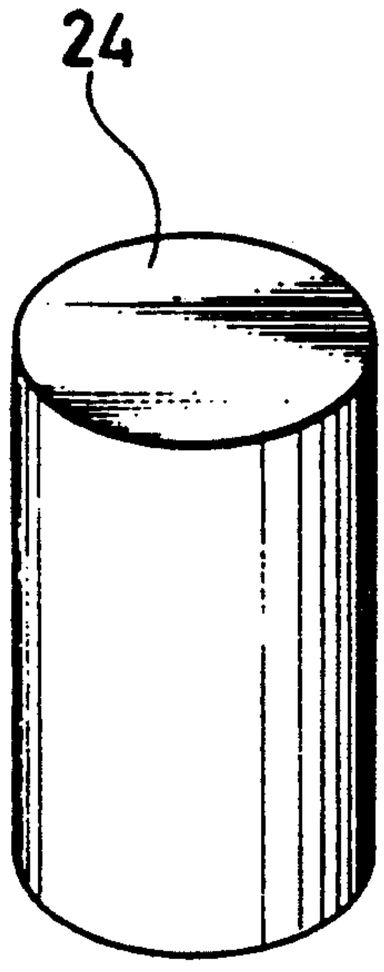


FIG. 3A

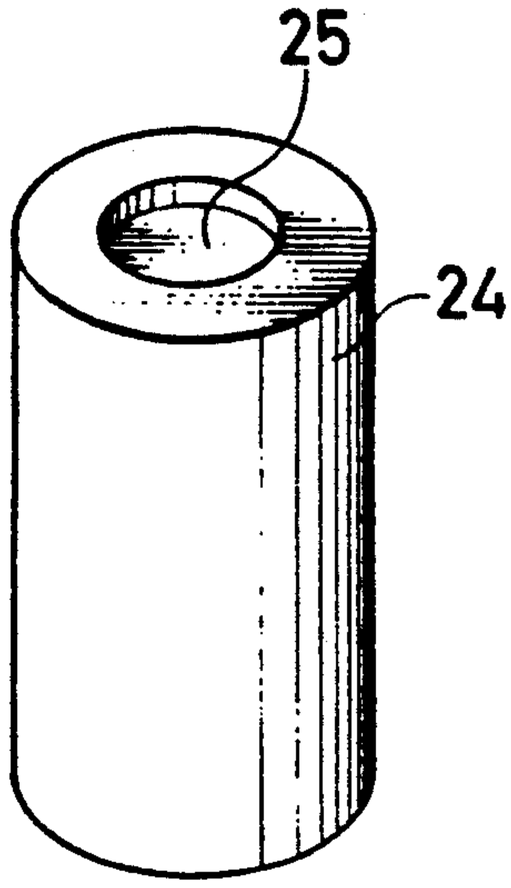


FIG. 3B

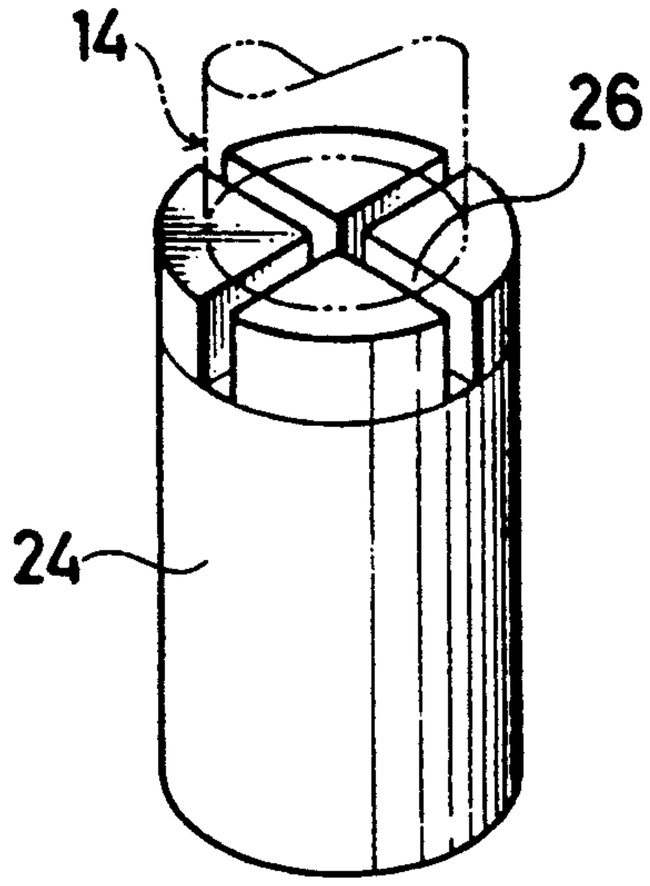


FIG. 3C

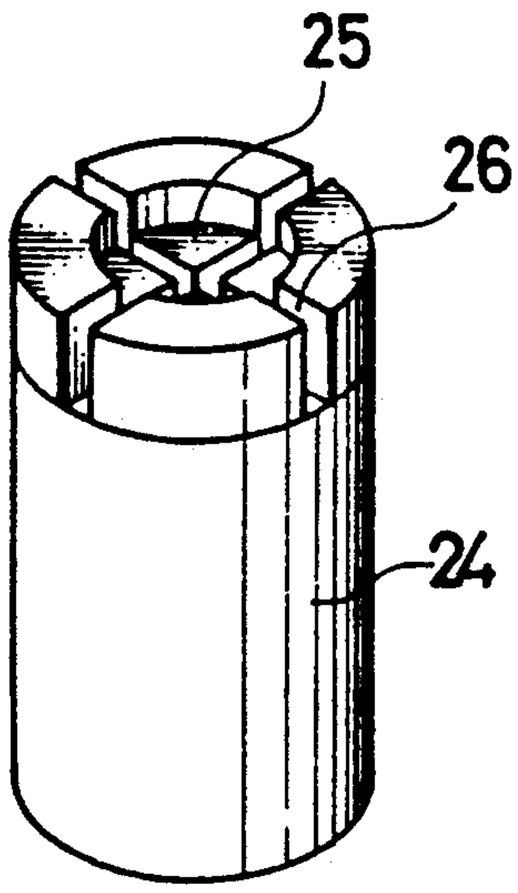


FIG. 3D

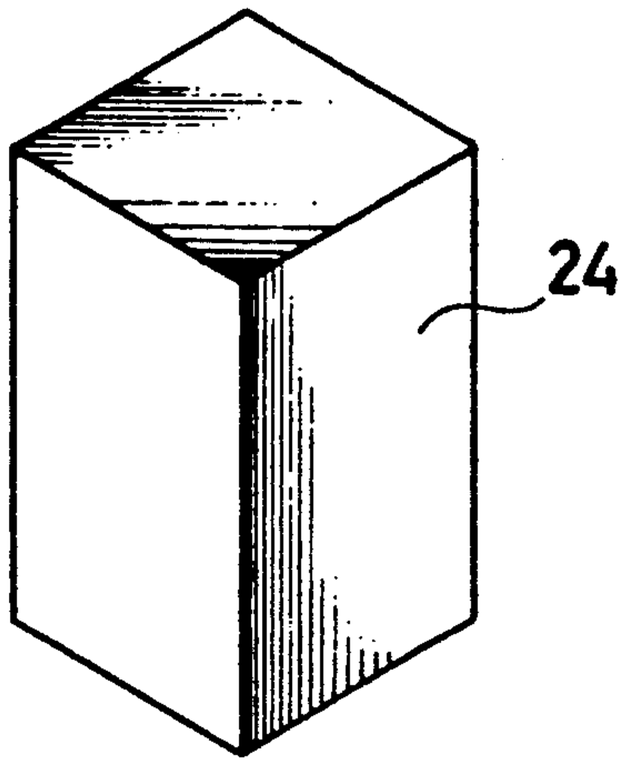
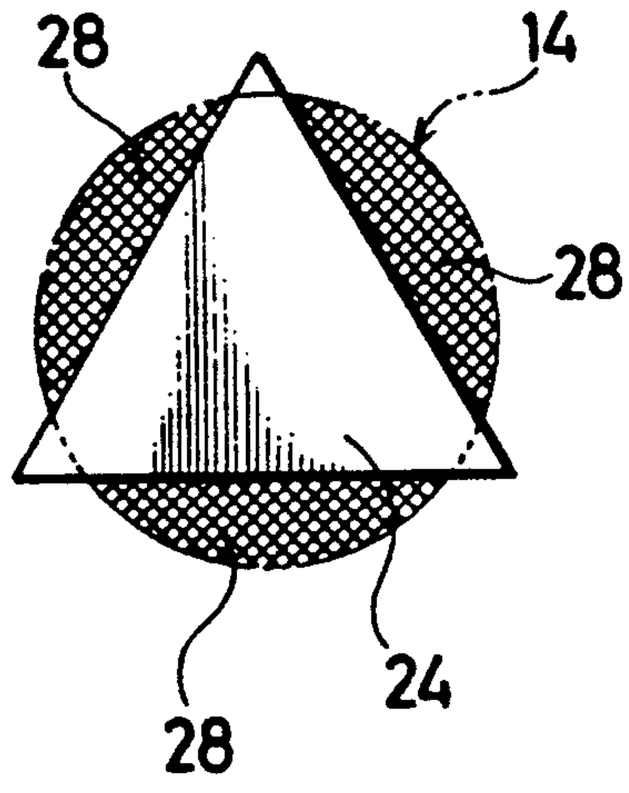


FIG. 4



LIQUID APPLICATION WITH RESILIENT SUPPORT

BACKGROUND OF THE INVENTION AND RELATED ART STATEMENT

This invention relates to liquid applicators including writing instruments such as ball-point pens and paint markers.

In general, the liquid applicators are each provided with a casing for accommodating a liquid holding member such as an ink reservoir. This casing is constructed such that an opening is provided at a lead end thereof while a bottom wall is provided at a bottom end thereof. These liquid applicators require a structure for supporting the liquid holding member in a specified position of the casing.

Japanese Unexamined Utility Model Publication No. 1-80391 discloses a liquid applicator in which a support member is provided between a bottom end of a liquid holding member and a bottom wall of a casing so as to support the liquid holding member. This support member is formed of flexible material such as plastics and has a plurality of support pieces extending outwardly, thereby forming a bell-like shape at a lead end thereof. The support member is pressingly fit into the casing with these support pieces warped radially inward.

Further, Japanese Unexamined Utility Model Publication No. 46-2727 discloses a liquid applicator in which a spring is provided between a bottom end of an ink cartridge serving as a liquid holding member and a bottom wall of a casing so as to support and bias the ink cartridge constantly toward the lead end of the applicator.

The support member disclosed in the former publication is complicated in its shape and accordingly it is difficult to mold the same. Further, this support member makes almost no deformation in an axial direction of the liquid applicator. This makes the assembling of the liquid applicator as a whole difficult even when the axial dimension of support member is only slightly greater than a specified dimension, and also leads to a compressive deformation of the liquid holding member in the case where the liquid holding member is soft, thereby hindering the liquid from flowing in a satisfactory manner. In view of the above, the axial dimension of the support member is forced to be set smaller than the specified dimension, with the result that a clearance is defined between the support member and a bottom face of the liquid holding member. Therefore, these members cannot be properly positioned relative to each other.

On the other hand, the liquid applicator disclosed in the latter publication requires a special means for positioning the spring lest the spring should be displaced in the radial direction of the applicator because there is a clearance between the spring and an inner circumferential surface of the casing. This requirement makes the construction of the liquid applicator complicated.

SUMMARY OF THE INVENTION

In view of these problems existing in the prior art, it is an object of the invention to provide a liquid applicator having a simply structured support member for reliably supporting a liquid holding member in a casing of the liquid applicator.

Accordingly, a liquid applicator of the invention comprises a tubular casing having an opening defined at a lead end thereof and having a bottom wall at a bottom end thereof; a liquid holding member which is contained in the casing: and a support member provided between a bottom end of the liquid holding member and the bottom wall of the casing, the support member having a modulus of elasticity smaller than that of the liquid holding member and being formed such that at least a portion of an outer circumferential surface of the support member is in pressing contact with an inner circumferential surface of the casing and that the support member is compressively deformable in an axial direction thereof while being held tightly between the liquid holding member and the bottom wall of the casing.

With the liquid applicator thus constructed, being constantly in pressing contact with the support member, the liquid holding member can be reliably supported. This prevents the liquid holding member and the support member from moving relative to each other in the casing. Further, since the bottom end portion of the liquid holding member is pressed against the elastic support member, thereby forming a recessed portion on the support member, the radial displacement of the liquid holding member relative to the support member can be also restricted.

It is preferably to form the support member of elastic material such as rubber and sponge. Particularly, if the support member is formed of open cell type sponge, there can be obviated the need to provide a special means for supplying the air to a main body of the liquid holding member. Thus formed support member is also advantageous in preventing leakage of ink toward the lead end of the liquid applicator because excess ink from the liquid holding member is soaked up with this support member.

Further, a recessed portion in which the bottom end portion of the liquid holding member is fitted may be formed on the lead end face of the support member. This is effective in reliably preventing the displacement of the liquid holding means relative to the support member.

The specific form of the support member does not particularly matter. However, in the case where the liquid holding member includes a main body and a cover for covering an outer circumferential surface of this main body, it may be advantageous to form on the lead end face of the support member a communication groove which functions to cause the bottom end face of the main body of the liquid holding member to communicate with the plenum in the casing. Alternatively, the support member may be formed such that the bottom end face of the main body of the liquid holding member bulges out of the lead end face of the support member. With this arrangement, the main body of the liquid holding member is permitted to communicate with the plenum in the casing despite the fact that the lead end face of the support member is entirely in pressing contact with the liquid holding member, and thereby the air can be smoothly supplied to the main body liquid holding member.

These and other objects, features and advantages of the present invention will become more apparent upon a reading of the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view in section showing an essential portion of a liquid applicator embodying the invention;

FIG. **2** is a perspective view showing a support member provided in the liquid applicator;

FIGS. **3A**, **3B**, **3C** and **3D** are perspective view showing modifications of the support member respectively; and

FIG. **4** is a diagram showing positional relationship between the support member in the form of a triangular column and an ink reservoir when viewed from an axial direction of the liquid applicator.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

An exemplary embodiment of the invention will be described in accordance with FIGS. **1** and **2**. The invention is applied to a paint marker in this embodiment. However, the invention is not limited to this application, but also applicable to various types of liquid applicators in which liquids are contained in casings thereof.

A liquid applicator shown in FIG. **1** is provided with a tubular casing **10** and a hollow lead portion **12** having a bore in communication with the plenum in the casing **10**. The casing **10** has an opening at a top end thereof and a bottom wall **10***b* at a bottom end thereof. The lead portion **12** is mounted in such a position as to block the opening of the casing **10**. More specifically, an external thread **10***a* is formed on an outer circumferential surface of a lead end portion of the casing **10** and an internal thread **12***a* is formed on an inner circumferential surface of a bottom end portion of the lead portion **12**. The casing **10** and the lead portion **12** are coupled with each other by spirally engaging these threads **10***a*, **12***a*.

In the casing **10** is contained an ink reservoir (liquid holding member) **14** for holding ink (liquid to be applied). This ink reservoir **14** includes a column-like main body **21** made of a bundle of fibers or the like and a tubular cover **22** made of polyethylene film or the like for covering an outer circumferential surface of the main body **21**. left end face and a right end face (FIG. **1**) of the main body **21** are not covered by the cover **22**, thereby being exposed. The lead end of the main body **21** is connected with a shaft **16** extending from a bottom end of a nib **18**, and a lead end of the nib **18** is projecting forward from the lead portion **12**. Further, between the casing **10** and the lead portion **12** is provided a seal member **20** made of elastic material such as rubber and polyethylene resin.

The feature of this liquid applicator is a support member **24** which is pressingly fitted between the bottom end of the ink reservoir **14** and the bottom wall **10***b* of the casing **10**. This support member **24** is made of rubber or sponge which is relatively subject to elastic deformation, and configured into a cylindrical form as shown in FIG. **2**. The support member **24** is formed such that the axial dimension thereof is slightly greater in its natural state than the distance between the bottom end face of the ink reservoir **14** and an inner face of the bottom wall **10***b* in an assembled state. Further, the diameter of the support member **24** in the natural state is slightly greater than the inner diameter of the casing **10** on condition that the support member **24** is pressingly insertable into the interior of the casing **10** through the opening thereof. The liquid applicator is assembled in the following order: 1) The support member **24** is pressingly inserted into the casing **10** through the opening thereof up to a position where the member **24** comes to contact with the bottom wall **10***b*; 2) The ink reservoir **14** is inserted into the casing **10**; and 3) The lead portion **12** is spirally coupled with the casing **10** while causing the seal member **20** to press the ink reservoir **14** inside from the lead end. In the assembled state, the ink reservoir **14** has opposite ends thereof tightly held by the seal members **20** and the support member **24**, and the support member **24** is held tightly between the bottom face of the ink reservoir **14** and the bottom wall **10***b*, thereby deforming compressively in the axial direction.

With this construction, the liquid applicator can be assembled such that the ink reservoir **14** and the support member **24** are constantly in pressing contact with each other because the support member **24** deforms compressively in the axial direction according to the distance between the ink reservoir **14** and the bottom wall **10***b*. The ink reservoir **14** can be pressed toward the lead end of the liquid applicator by the elastic force rendered from the support member **24** in a deformed state, and thereby the support member **24** can support the ink reservoir **14** reliably. Further, the variation of the distance between the ink reservoir **14** and the bottom wall **10***b* is absorbed by the compressive deformation of the support member **24**. This obviates the high accuracy requirement for the axial dimensions of the respective members, thereby facilitating the manufacturing of the liquid applicator. In addition, the shape of the support member **24** itself is simple and easy to be molded.

Further, since the elastic support member **24** is in pressing contact with the ink reservoir **14**, a contact portion thereof with the ink reservoir **14** is indented, thereby forming a recessed portion **23**. The bottom end portion of the ink reservoir is fitted and held in this recessed portion **23**. In view of this, the recessed portion **23** is advantageous in restricting a radial displacement of the ink reservoir **14** relative to the support member **24**.

Moreover, the support member **24** is contained in the casing **10** while being compressed in the radial direction of the liquid applicator, i.e. in a state where the outer circumference surface of the support member **24** is in pressing contact with the inner circumferential surface of the casing **10**. Accordingly, the support member **24** is prevented from moving radially without providing any special structure.

It does not matter which specific material is used to form the support member **24**, but it is important to use material at least whose modulus of elasticity is smaller than that of the ink reservoir **14** in order to prevent the ink reservoir **14** from deforming compressively in the assembled state. In the construction shown in FIG. **1**, the support member **24** may be formed of elastic material which is more subject to the elastic deformation than the cover **22** which is the harder part of the ink reservoir **14**.

In the case where sponge is selected as material for the support member **24**, the ink held by the ink reservoir **14** can be prevented from transferring to the support member **24** if the closed cell type sponge is used. However, in this case, it is very preferable to omit the cover **22**, to form the cover **22** of material through which the air is permeable such as an unwoven cloth, or to form an air hole in a specified position of the cover **22**, so that the air in the casing **10** is supplied to the main body **21** while the ink is being applied. On the contrary, the use of the open cell type sponge has the following advantages: 1) There can be obviated the need for a special

means for supplying the air to the main body **21**; and 2) Since excess ink from the ink reservoir **14** is soaked up with the support member **24**, leakage of ink toward the nib **18** can be prevented.

It does not matter which specific shape the support member **24** takes either. The shape of the support member **24** will do so long as at least a portion of the outer circumferential surface of the support member **24** is in pressing contact with the inner circumferential surface of the casing **10**, and the support member **24** is compressed in the axial direction.

For instance, a recessed portion **25** may be actively formed on the lead end face of the support **24** as shown in FIG. 3A. If the bottom end portion of the ink reservoir **14** is fitted in this recessed portion **25**, the radial displacement of the ink reservoir **14** relative to the support member can be prevented more reliably. Further, the support member **24** may have communication grooves **26** formed on the lead end face thereof, the grooves **26** extending diametrically and opening upward as shown in FIG. 3B. With these communication grooves **26**, the bottom face of the main body **21** of the ink reservoir **14** is allowed to be exposed to the air in the casing **10** through the communication grooves **26** even in the state where the bottom face of the ink reservoir **14** is in pressing contact with the support member **24**. Accordingly, even if the outer circumferential surface of the main body **21** is entirely covered by the cover **22**, the air can be smoothly supplied to the main body **21** through the communication grooves **26** while the ink is being applied. Further, as shown in FIG. 3C, both the recessed portion **25** and the communication grooves **26** may be formed on the lead end face of the support member **24** in a combined manner.

The overall shape of the support member **24** is not limited to a cylindrical shape, but may be polyhedrons including a rectangular column shown in FIG. 3D. In the case of the polyhedrons, the outer circumferential surface of the support member **24** are not in contact with the inner circumferential surface of the casing **10** entirely, but the outer circumferential surface of corner portions of the polyhedrons are deformed and thereby come to contact with the inner circumferential surface of the casing **10**. Even in this state, the support member **24** can be positioned radially reliably, Further, in the case where the support member **24** is a polyhedral column, particularly a triangular column, an area **28** of the ink reservoir **14** bulging out of the support member **24** (crisscrossed area in FIG. **4**) when viewed from the axial direction is increased as shown in FIG. **4**. The air can be smoothly supplied to the main body **21** of the ink reservoir **14** through the area **28** without providing the aforementioned communication grooves **26** or the like specially for that purpose. Besides cases where the support member **24** is a polyhedral column, the above effect is obtainable provided that the bottom face of the main body **21** bulges out of the lead end face of the support member **24**.

According to the invention, the liquid holding member is not limited to the ink reservoir **14** shown in FIG. **1**, but may have various other structures so long as it is adapted to hold the liquid.

As described above, according to the invention, a support member whose modulus of elasticity is smaller than a liquid holding member is provided between a bottom end of the liquid holding member and a bottom wall of a casing of a liquid applicator. At least a portion of an outer circumferential surface of the support member is in pressing contact with an inner circumferential surface of the casing, and the support member is so formed as to deform compressively in a state where it is held tightly between the liquid holding member and the bottom wall of the casing. Accordingly, the liquid holding member can be supported reliably while bringing the liquid holding member and the support member into pressing contact with each other. This prevents the liquid holding member and the support member from moving relative to each other. In addition, a bottom end portion of the liquid holding member is pressed against and held in a recessed portion formed on the support member. This arrangement restricts a radial displacement of the liquid holding member relative to the support member.

Further, the variation of the distance between the liquid holding member and the bottom wall is absorbed by compressive deformation of the support member. This obviates the high accuracy requirement for the axial dimensions of the respective members, thereby facilitating the manufacturing of the liquid applicator. In addition, the shape of the support member **24** itself is simple and easy to be molded. Thus, a manufacturing cost can be reduced.

Moreover, this support member is contained in the casing while being compressed in the radial direction of the liquid applicator, i.e. in a state where the outer circumference surface of the support member are in pressing contact with the inner circumferential surface of the casing. Accordingly, the support member is prevented from moving radially without providing any special structure.

Further, by fitting the bottom end portion of the liquid holding member in the recessed portion formed on the lead end face of the support member, the radial displacement of the liquid holding member relative to the support member can be more reliably prevented.

Also, by forming a communication groove on the lead end face of the support member, or causing a main body of the liquid holding member to bulge out of the circumference of the support member, the main body of the liquid holding member is exposed to the air in the casing despite the fact that the support member is in pressing contact with the liquid holding member. Accordingly, even if the outer circumferential surface of the liquid holding member is covered entirely by a cover, the air can be smoothly supplied to the main body of the liquid holding member through the exposed area thereof.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

What is claimed is:

1. A liquid applicator comprising:

a cylindrical casing having an opening defined at a lead end thereof and having a bottom wall at a bottom end thereof;

a liquid holding member which is contained in the casing; and

a polyhedral support member provided between a bottom end of the liquid holding member and the bottom wall of the casing, the support member having a modulus of elasticity smaller than that of

the liquid holding member and being formed such that vertices of the support member are in pressing contact with an inner circumferential surface of the casing and that the support member is compressively deformable in an axial direction thereof while being held tightly between the liquid holding member and the bottom wall of the casing, wherein the support member is formed of an elastic material.

2. A liquid applicator as defined in claim 1 wherein the support member is formed of open cell type sponge.

3. A liquid applicator as defined in claim 1, wherein a recessed portion in which the bottom end portion of the liquid holding member is fitted on a lead end face of the support member.

4. A liquid applicator as defined in claim 1 or 2 wherein the liquid holding member includes a main body and a cover for covering only an outer circumferential surface of the main body, and wherein a communication groove is formed on the lead end face of the support member so as to make the bottom end face of the main body of the liquid holding member communicate with the plenum in the casing.

5. A liquid applicator as defined in claim 1 or 2 wherein the liquid holding member includes a main body and a cover for covering only an outer circumferential surface of the main body, and wherein the support member is formed such that the bottom end face of the main body of the liquid holding member extends from the lead end face of the support member.

6. A liquid applicator as defined in claim 1, wherein the support member is in the form of a rectangular column.

7. A liquid applicator as defined in claim 1, wherein the liquid holding member includes a main body and a cover for covering only an outer circumferential surface of the main body, the liquid holding member being a cylindrical form having a diameter greater than the distance between the opposite sides of the polyhedral support member, whereby providing the liquid holding member with such bottom portions outside the polygonal top plane of the support member as to communicate with the plenum in the casing.

8. A liquid applicator as defined in claim 1, wherein the side wall of the casing has a neck portion having a first diameter and a main portion having a second diameter greater than the first diameter, the neck portion having a predetermined axial length for keeping the liquid holding member from moving in a radial direction.

9. A liquid applicator as defined in claim 1, wherein the material from which the support member is formed is selected from the group consisting of rubber and sponge.

10. A liquid applicator as defined in claim 3, wherein the liquid holding member includes a main body and a cover for covering only an outer circumferential surface of the main body, and wherein a communication groove is formed on the lead end face of the support member so as to make the bottom end face of the main body of the liquid holding member communicate with a plenum in the casing.

11. A liquid applicator as defined in claim 4, wherein the liquid holding member includes a main body and a cover for covering only an outer circumferential surface of the main body, and wherein the support member is formed such that the bottom end face of the main body of the liquid holding member extends from the lead end face of the support member.

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